

Claims

- [c1] 1. A magnetic field generator for producing a homogeneous magnetic field region, the magnetic field generator comprising:
 - a plurality of main magnet coils arranged in a cylindrical fashion;
 - a plurality of shielding coils arranged in a cylindrical fashion, and located radially outward of the plurality of magnets; and
 - wherein the main magnet coils and shielding coils are configured to shape a magnetic field which comprises at least one low fringe field region when in operation.
- [c2] 2. The magnetic field generator of claim 1 further comprising negative coils to help shape magnetic field in the imaging volume
- [c3] 3. The magnetic field generator of claim 1, further comprising: electronics; and wherein the electronics are located in the at least one low fringe field region when the magnetic field generator is in operation.
- [c4] 4. The magnetic field generator of claim 3, wherein the electronics may comprise: a gradient amplifier unit; an RF

amplifier unit; a system controller; and a magnet monitor unit.

- [c5] 5. The magnetic field generator of claim 3, further comprising:
 - a housing; and
 - wherein the electronics are located radially outward of the housing.
- [c6] 6. The magnetic field generator of claim 1, wherein the at least one low fringe field region is less than about 50 gauss.
- [c7] 7. The magnetic field generator of claim 1, wherein the at least one low fringe field region is less than about 10 gauss.
- [c8] 8. The magnetic field generator of claim 1, wherein the at least one low fringe field region is less than about 2.5 gauss.
- [c9] 9. The magnetic field generator of claim 5, wherein the at least one low fringe field region comprises a toroidal volume around the housing.
- [c10] 10. The magnetic field generator of claim 5, wherein the electronics occupies a toroidal volume around the housing.

- [c11] 11. The magnetic field generator of claim 1, wherein the magnets are superconducting coils.
- [c12] 12. A magnetic resonance imaging system comprising:
 - a plurality of main magnet coils;
 - a plurality of shielding coils located radially outward from the plurality of main magnet coils;
 - a housing that houses the main magnet coils and the shielding coils;
 - electronics for operating the magnetic resonance imaging system, the electronics located radially outward of the housing and proximal to the housing; and
 - wherein the main magnet coils and shielding coils are configured such that they shape a magnetic field to comprise at least one low fringe field region when in operation.
- [c13] 13. The magnetic resonance imaging system of claim 12, wherein the electronics are located in the low fringe field region when the magnetic resonance imaging system is in operation.
- [c14] 14. The magnetic resonance imaging system of claim 13, wherein the electronics comprise:
 - a gradient amplifier unit;
 - an RF amplifier;

a system controller; and
a magnet monitor.

- [c15] 15. The magnetic resonance imaging system of claim 12, wherein the at least one low fringe field region is less than about 50 gauss.
- [c16] 16. The magnetic resonance imaging system of claim 12, wherein the at least one low fringe field region is less than about 10 gauss.
- [c17] 17. The magnetic resonance imaging system of claim 12, wherein the at least one low fringe field region is less than about 2.5 gauss.
- [c18] 18. The magnetic resonance imaging system of claim 12, wherein at least one low fringe field region comprises a toroidal volume around the housing.
- [c19] 19. The magnetic resonance imaging system of claim 12, wherein the electronics occupies a toroidal volume around the housing.
- [c20] 20. The magnetic resonance imaging system of claim 12, wherein the magnets are superconducting coils.
- [c21] 21. A method for designing an MRI system that produces a low fringe field region, the method comprising:
defining a solution space;

defining a field of view, a center field and homogeneity requirements;
defining fringe field requirements; and
running an optimization algorithm to determine coil positions.

- [c22] 22. The method of claim 21, further comprising:
determining whether the coil positions are feasible; and
determining whether an MRI system with the coil positions is manufacturable.
- [c23] 23. A storage medium encoded with machine-readable computer program code for designing an MRI system that produces a low fringe field region, the storage medium including instructions for causing a computer to implement a method comprising:
defining a solution space;
defining a field of view, a center field and homogeneity requirements;
defining fringe field requirements; and
running an optimization algorithm to determine coil positions.